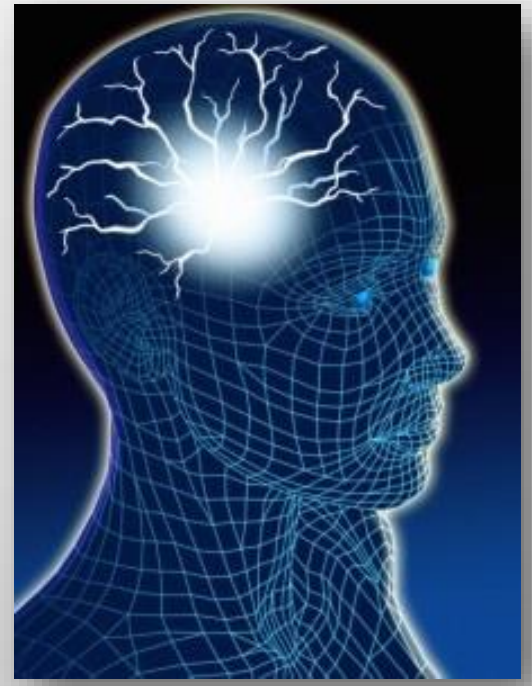
Intelligent Agents



Chapter 2

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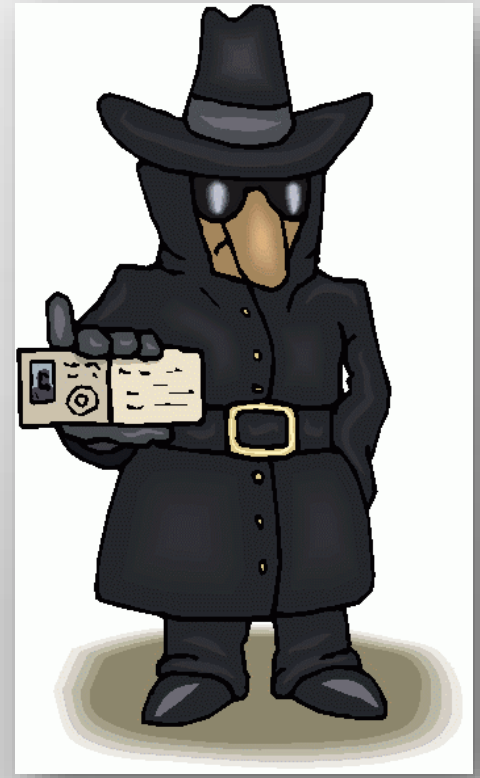
Announcements

- None

Lecture outline

- The structure of agents
  - Agent programs
  - Simple reflex agents
  - Model-based agents
  - Goal-based agents
  - Utility based agents
  - Learning agents



Agent programs

- Behavior of agent is discussed first
- Agent program takes current percept and produces action for actuators
- Agent = Architecture + Program
- Figure 2.7 shows Table-Driven-Agent
- Unfortunately, it does not work! :-(
  - Let *P* be the set of possible percepts
  - Let *T* be the lifetime of the agent
  - The table will contain the following number of entries: $\sum_{t=1}^{T} |P|^t$

Agent programs

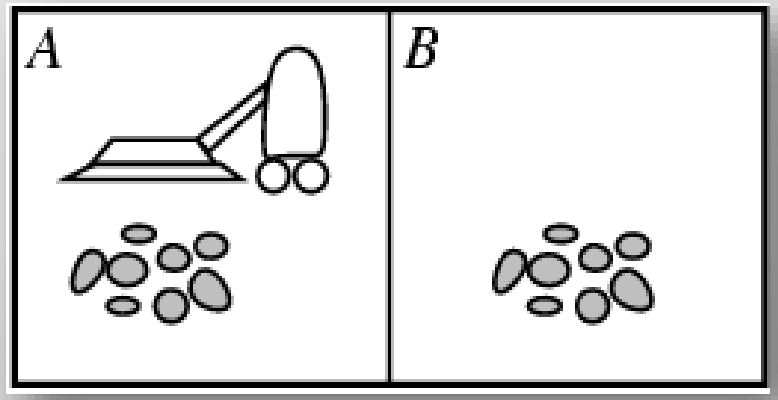
- Example: automated taxi
  - Table has $10^{600'000'000'000}$ entries for one hour (± 70 MB/s, 30 fps, 1080 x 720 pixels, 25 bits)
  - Chess > 10^{150}, number of atoms in observable universe < 10^{80}
- Table is way too big!
  - No physical agent has enough storage space
  - Designer won't have enough time to create the table
  - No agent can learn all the correct table entries from experience

Agent programs

- Table-Driven-Agent implements agent function
- Challenge for Artificial Intelligence
  - Create rational behavior from a relative small amount of code rather than a large number of table entries
  - We believe it is possible!
- Discuss four basic types of agent programs
- Convert these programs to agents that can learn

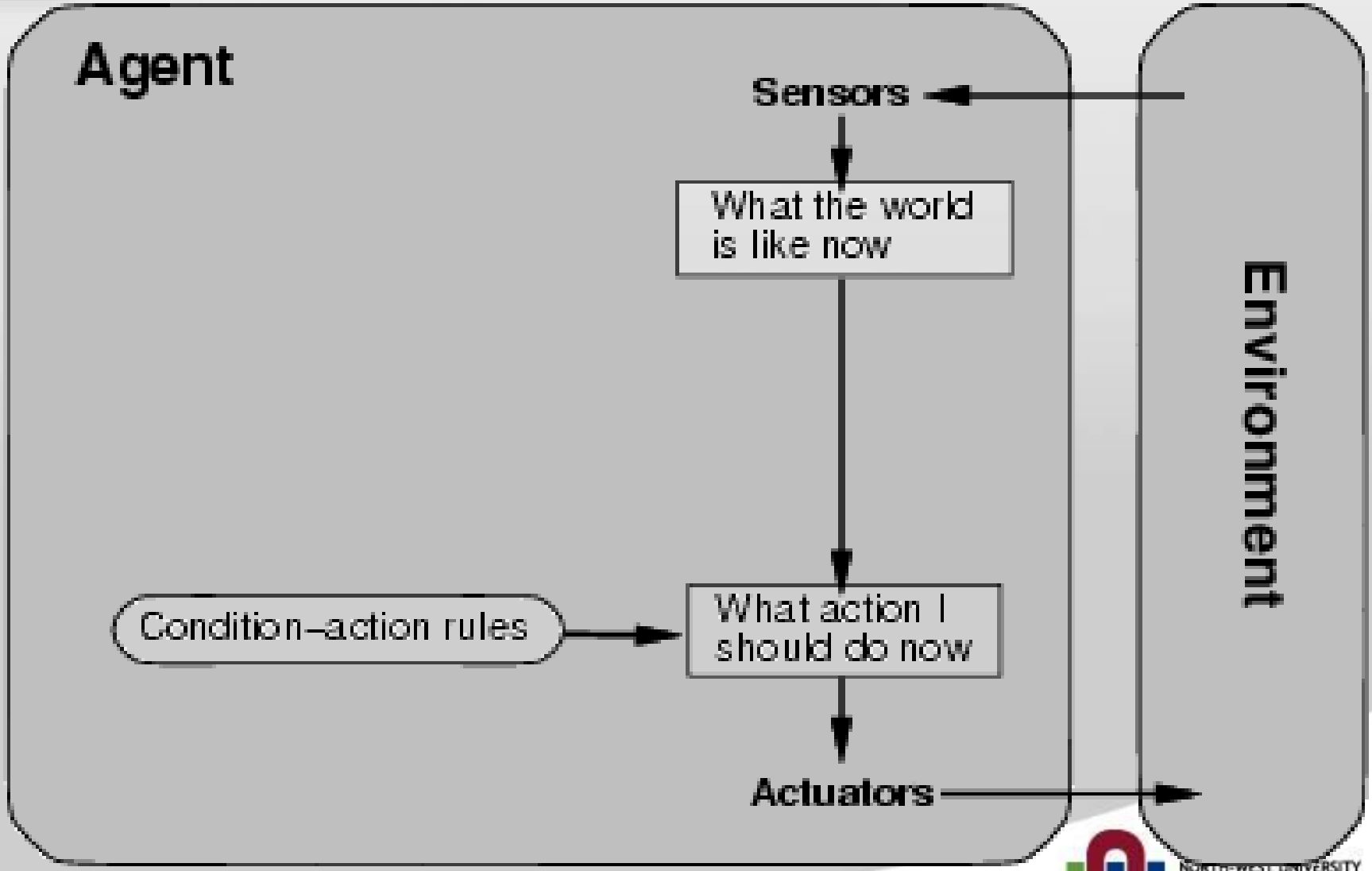
Simple reflex agents

- Actions based on current percept



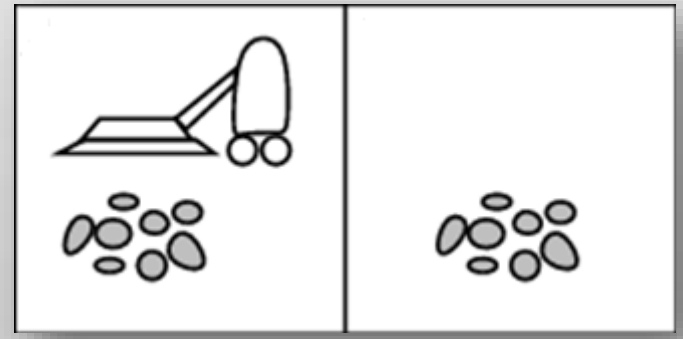
- Vacuum agent program small (4 possibilities) compared to table (4^T possibilities)
- Taxi example

Simple reflex agents



Simple reflex agents

- Reflex agents simple, but with limited intelligence

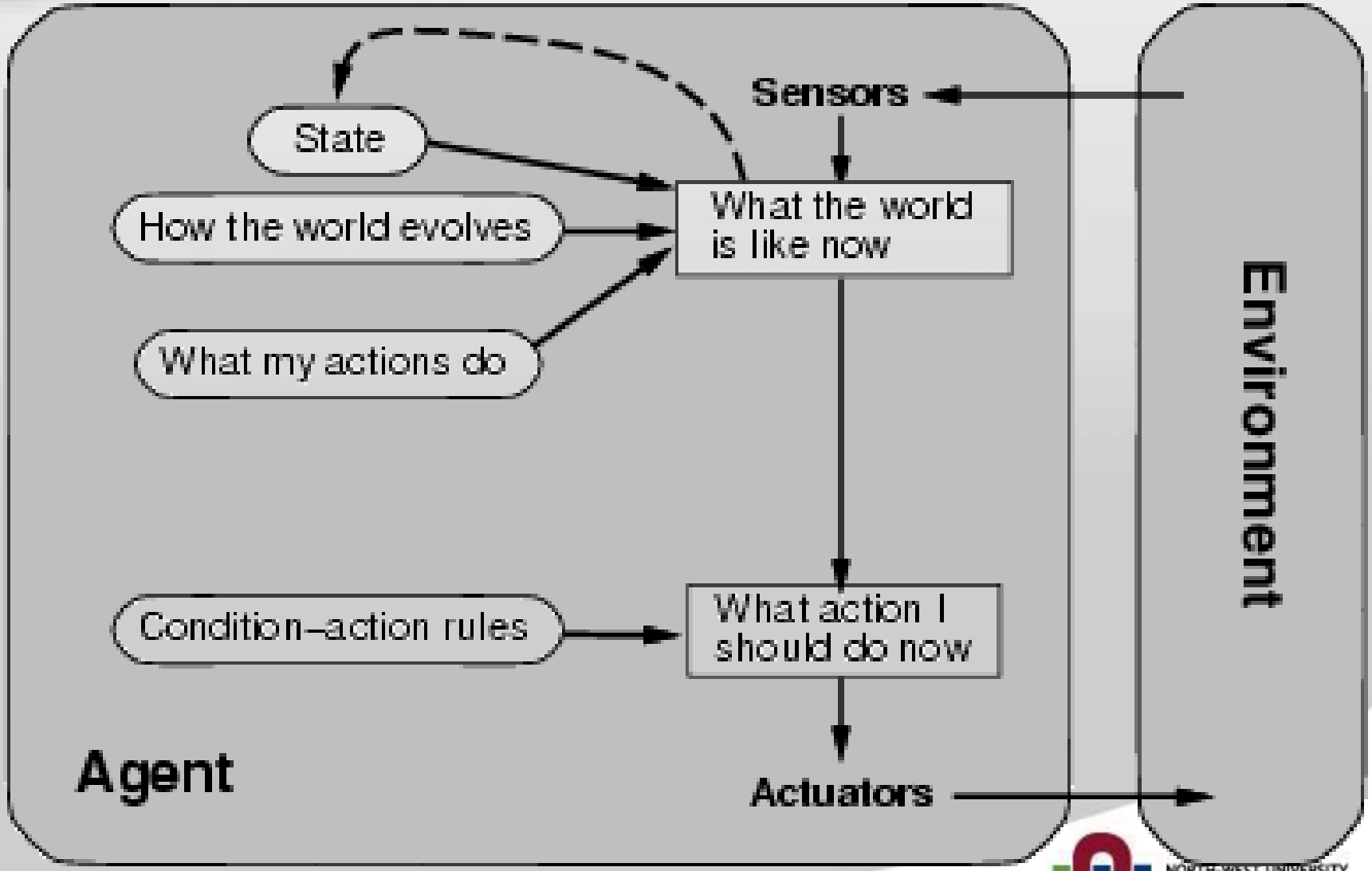


- Infinite loops occur frequently
- Solution: randomized actions

Model-based reflex agents

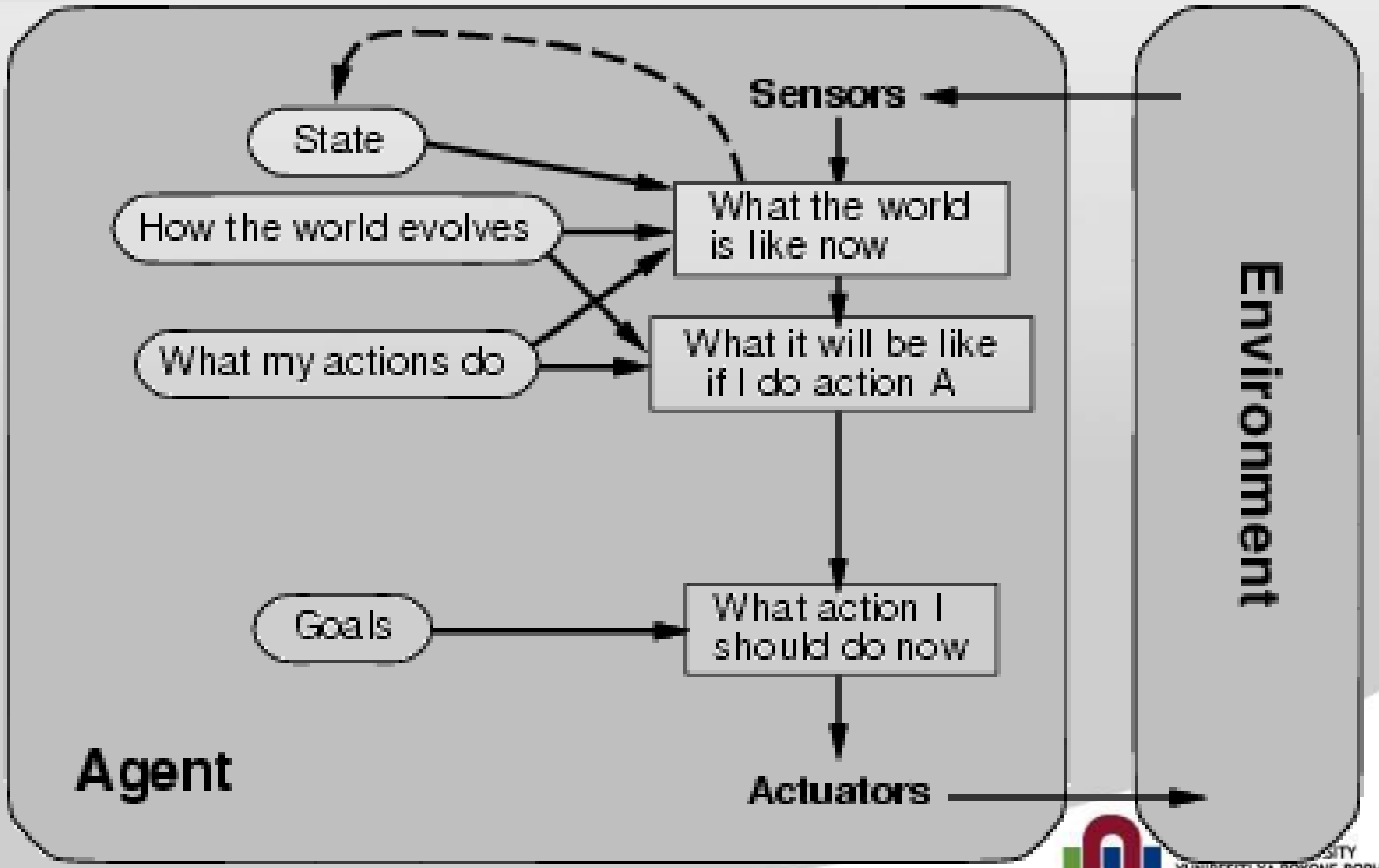
- Handle partial observability by keeping track of world which is not observable
- Maintain an internal state that depends on the percept sequence
- Update internal state with two types of knowledge
  - How the world develops independent of the agent
  - How the agent's actions influence the world
- We also need some information about how the state of the world is reflected in the agent's percepts

Model-based reflex agents



Goal-based agents

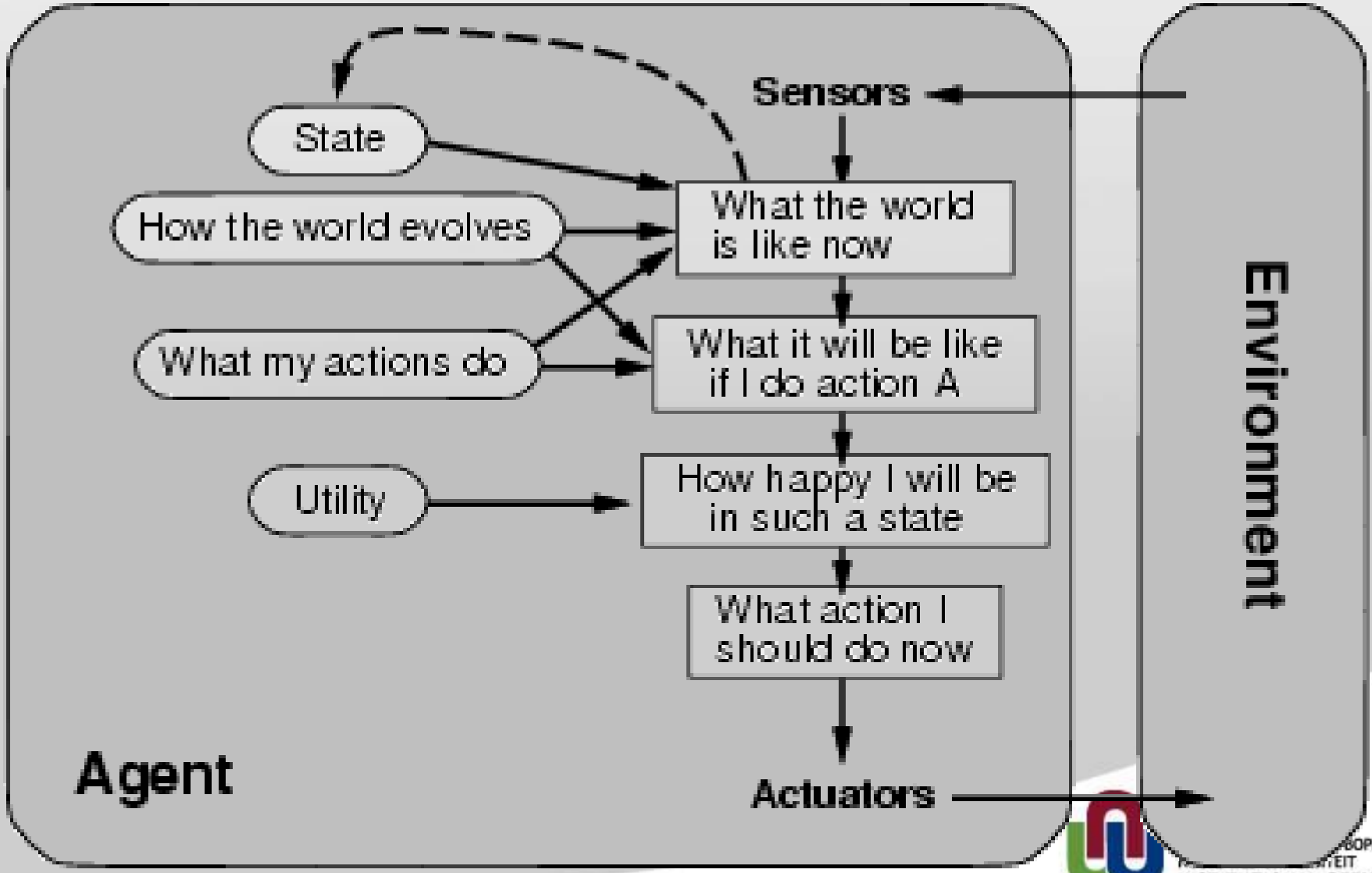
Goal-based agents



Utility-based agents

- Goals not enough
- Better option is utility
- Utility function
- Improvement on goal-based agents
  - If goals compete with each other
  - If many goals exist, but no one can be obtained with certainty

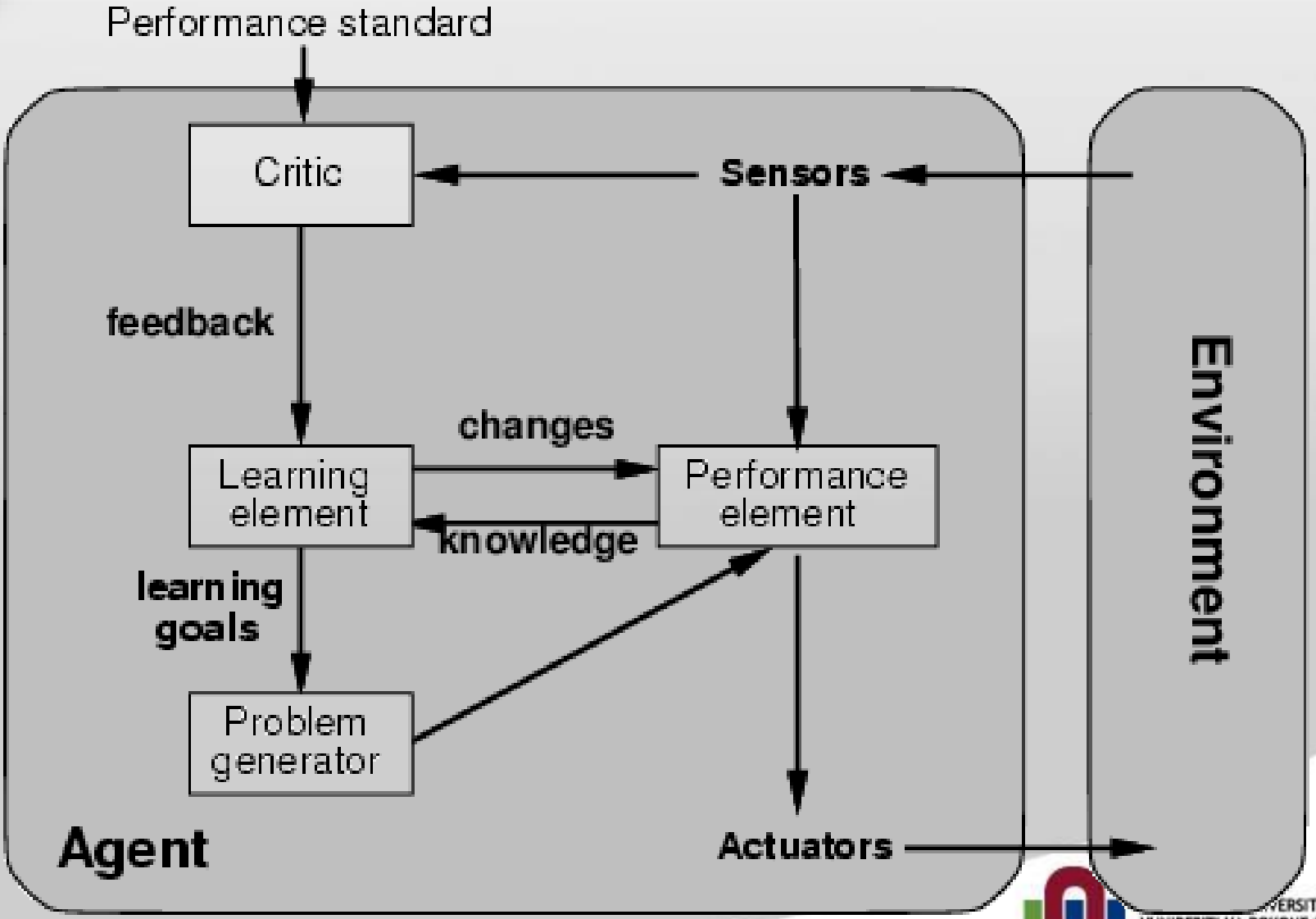
Utility-based agents



Agents that learn

- Consider the origin of agents
- Turing suggested the building of machines capable of learning in 1950
- Agents that learn currently the preferred method
- Advantage
  - Start operating initially in unknown environment and gets more competent

Agents that learn



Assignment

- Recess: From 29 March to 1 April
- Study: Chapter 2.4 (The Structure of Agents) of the AIMA e-book
- Self-study: Chapter 2 (Fundamental concepts) of the Grokking Deep Learning e-book
- 8 April: Theory Quiz 3: Chapter 2.4 (The Structure of Agents) of the AIMA e-book
- 8 April: Practical Quiz 2: Chapter 2 (Fundamental concepts) of the Grokking Deep Learning e-book